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Modeling and Numerical Simulation of Heat Transfer and Internal Loads at Insulating Glass Units

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Abstract : The insulating glass units (IGU) are widely used in the advanced and renovated buildings in order to reduce the energy for heating and cooling. Rules for the choice of IGU to ensure energy efficiency and thermal comfort in the indoor space are well known. The existing of internal loads - gage or vacuum pressure in the hermetized gas space, requires additional attention at the design of the facades. The internal loads appear at variations of the altitude, meteorological pressure and gas temperature according to the same at the process of sealing. The gas temperature depends on the presence of coatings, coating position in the transparent multi-layer system, IGU geometry and space orientation, its fixing on the facades and varies with the climate conditions. An algorithm for modeling and numerical simulation of thermal fields and internal pressure in the gas cavity at insulating glass units as function of the meteorological conditions is developed. It includes models of the radiation heat transfer in solar and infrared wave length, indoor and outdoor convection heat transfer and free convection in the hermetized gas space, assuming the gas as compressible. The algorithm allows prediction of temperature and pressure stratification in the gas domain of the IGU at different fixing system. The models are validated by comparison of the numerical results with experimental data obtained by Hot-box testing. Numerical calculations and estimation of 3D temperature, fluid flow fields, thermal performances and internal loads at IGU in window system are implemented.

Keywords : insulating glass units, thermal loads, internal pressure, CFD analysis
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